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ENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. RE Unc			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY ---			3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.		
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE ---			4. MONITORING ORGANIZATION REPORT NUMBER(S) ---		
4. PERFORMING ORGANIZATION REPORT NUMBER(S) ARI Research Product 38-13			5. MONITORING ORGANIZATION REPORT NUMBER(S) ---		
6a. NAME OF PERFORMING ORGANIZATION Applied Science Associates, Inc.		6b. OFFICE SYMBOL (If applicable) ---	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences		
6c. ADDRESS (City, State, and ZIP Code) PO Box 1072 Butler, PA 16003-1072		7b. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600			
8a. NAME OF FUNDING / SPONSORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences		8b. OFFICE SYMBOL (If applicable) PERI-SM	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER MDA903-85-C-0078		
8c. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600		10. SOURCE OF FUNDING NUMBERS			
		PROGRAM ELEMENT NO. 62717A	PROJECT NO. 2Q162 717A790	TASK NO. 1.4.2.	WORK UNIT ACCESSION NO. 1520
11. TITLE (Include Security Classification) Implementing Embedded Training (ET): Volume 3 of 10: The Role of ET in the Training System Concept					
12. PERSONAL AUTHOR(S) J. Thomas Roth					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM 11/84 TO 03/88		14. DATE OF REPORT (Year, Month, Day) 1988 April	
15. PAGE COUNT 75					
16. SUPPLEMENTARY NOTATION The Contracting Officer's Representative was Dorothy L. Finley.					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP			
			Embedded training Training system concept		
			Early training estimation Training system		
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
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20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED / UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Dorothy L. Finley			22b. TELEPHONE (Include Area Code) (202) 274-8076		22c. OFFICE SYMBOL PERI-SM

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Research Product 88-13

**Implementing Embedded Training (ET):
Volume 3 of 10:
The Role of ET in the
Training System Concept**

**Manned Systems Group
Systems Research Laboratory**

April 1988



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U. S. Army Research Institute for the Behavioral and Social Sciences

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U. S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the
Deputy Chief of Staff for Personnel

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Accession For	
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**Implementing Embedded Training (ET):
Volume 3 of 10:
The Role of ET in the
Training System Concept**

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April 1988

Army Project Number
2Q162717A790

Human Performance Effectiveness
and Simulation

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FOREWORD

This document is Volume 3 of a series produced by the Army Research Institute for the Behavioral and Social Sciences (ARI) and the Project Manager for Training Devices (PM TRADE). The series consists of 10 related documents that present guidance for combat and training systems developers, including Army Materiel Command (AMC) laboratories, Training and Doctrine Command (TRADOC) Combat Developers and Training Developers, and contractor organizations involved in system development or technological thrust areas under internal research and development (IR&D) programs.

This series of documents includes guidelines and procedures that support the effective consideration, definition, development, and integration of embedded training (ET) capabilities for existing and developmental systems. The 10 documents share the general title of Implementing Embedded Training (ET), with specific, descriptive subtitles for each document. They are as follows:

1. Volume 1: Overview presents an overall view of the guidance documents and their contents, purposes, and applications. This includes a discussion of these factors:
 - a. the total training system concept, including embedded training;
 - b. how training systems must develop within more general processes of materiel system development;
 - c. how embedded training must affect this relationship; and
 - d. the content and uses of the remaining documents in the series, their relationships to the training systems development and acquisition processes, and how to use them.
2. Volume 2: ET as a System Alternative provides guidelines for the initial decision as to whether ET should be further considered as an alternative training system for a given materiel system. It also includes guidance on considering ET as an alternative for systems under product improvement or modification, after fielding.
3. Volume 3: The Role of ET in the Training System Concept contains guidance for the early estimation of training system requirements and the potential allocation of such requirements to ET.
4. Volume 4: Identifying ET Requirements presents procedures for defining ET requirements (ETRs) at both initial levels (i.e., before initiating system development) and for revising and updating initial ETRs during system design and development.
5. Volume 5: Designing the ET Component contains analytic procedures and guidance for designing an ET component concept for a materiel system, based on specified ETRs.

6. Volume 6: Integrating ET with the Prime System contains considerations, guidance, and "lessons learned" about factors that influence the effective integration of ET into materiel systems.
7. Volume 7: ET Test and Evaluation presents guidance for defining the aspects of the ET component (test issues) to be addressed in prototype and full-scale system testing.
8. Volume 8: Incorporating ET into Unit Training provides guidance for integrating ET considerations and information into unit training documentation and practice.
9. Volume 9: Logistics Implications presents guidance on regarding key logistics issues that should be addressed in the context of ET integration with prime item systems.
10. Volume 10: Integrating ET into Acquisition Documentation provides guidance on developing the necessary documentation for, and specification of, an ET Component of a prime item during the Army's systems development and acquisition process. This document discusses the Life Cycle System Management Model (LCSMM) and the Army Streamlined Acquisition Process (ASAP) and describes where and how to include ET considerations in the associated documentation. It also describes where and how to use the other volumes in the ET Guidelines series to generate the information required for the acquisition documentation and provides guidance in preparing a contract Statement of Work for an ET Component to a prime item system.



EDGAR M. JOHNSON
Technical Director

IMPLEMENTING EMBEDDED TRAINING (ET): VOLUME 3 OF 10:
THE ROLE OF ET IN THE TRAINING SYSTEM CONCEPT

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IMPLEMENTING EMBEDDED TRAINING (ET):
VOLUME 3 of 10: THE ROLE OF ET IN THE TRAINING SYSTEM CONCEPT

INTRODUCTION

↙
The procedures presented in this document provide a means for generating potential training system concepts (in this case, limited to hands-on training support approaches) very early in the materiel system acquisition cycle. These procedures support the identification of hands-on training support concepts including embedded training (ET), stand-alone training devices (SADs), and conventional hands-on training approaches such as exercises, range firing, etc.

The training subsystem accompanying a new materiel system must be fielded prior to or concurrent with the materiel system. In order for this to occur, early and continuous consideration of training must take place. The procedures described here support the consideration of training support requirements at a functional performance level, prior to detailed analysis of crew or maintainer performance requirements. These procedures thus provide a means of considering appropriate alternative solutions to hands-on training needs in several training situations anticipated to be encountered for practically all types of systems. These procedures can also support the tradeoff between alternate soldier-system interfaces (SSIs) in the system design process. Possible alternate implications for training (embedded training, stand-alone training devices, etc.) associated with SSI design alternatives can be evaluated by applying these procedures to candidate SSI designs.

→ Keywork in 1-673 →
The training system concept development process supports the development of critical acquisition documents during the pre-concept and concept phases of the system acquisition process. Specific documents which may be impacted by these procedures include the first iterations of the organizational and operational (O&O) plan, the system training plan (STRAP), and the required operational capability (ROC) document; the justification for major system new start (JMSNS); evaluations of the possible inclusion of ET components; and preliminary training device requirements (TDR) documents.

These proceedings articulate with two other documents in the Implementing Embedded Training (ET) series. These are: Volume 2: ET as a System Alternative; and Volume 4: Identifying ET Requirements. If the recommended analytic procedures described in Volume 2 have been performed, the information generated by those procedures can be used as input for the procedures presented here. Likewise, the data generated as a result of the procedures discussed here can be used as an initial database for Volume 4 procedures to define ET requirements later in the acquisition process.

Limitations of the Procedures

These procedures provide an approach to developing a training system concept early in the system acquisition process. However, the procedures have certain limitations with respect to their coverage of the total training system. These are summarized below.

1. The procedures deal with general and global functional performance requirements for system crews or operators and maintainers rather than specific task-level training requirements. Specific training requirements are not anticipated to exist at the point in the life cycle (pre-concept) this procedure is expected to be used.
2. The procedures deal principally with hands-on training. This means that non-hands-on training (e.g., cognitive or knowledge training that does not involve hands-on activity) is not explicitly dealt with. This does not exclude cognitive or knowledge activities that may be practiced hands-on, however.
3. The procedures deal with training at the individual and crew-collective levels (and generic maintenance). Command, professional development, leadership, branch, and force-level training are not explicitly dealt with here. This is based on the assumption that, except in relatively rare cases, there is no emphasis in such training situations for system-related hands-on training. To the extent that such training is performed hands-on, however, it may be considered in these procedures. Where such functions are to be considered, they should be treated as crewmember or operator functions in these procedures. Specific positions (Step 1) should be identified for supervisors, leaders, or commanders, as applicable.

Overview of the Procedures

The procedures for developing a training system concept consist of nine steps. The first seven steps consist of identifying hands-on training requirements (at a functional performance requirements [FPR] level), and selecting appropriate means of hands-on training support for each FPR, for a number of specific training situations. The final two steps are concerned with integrating the results of the first seven steps, to develop an overall hands-on training support concept, and with documenting the concept in an easily understandable form.

The remainder of this document presents the procedures for each of the nine steps, in sequence. This document also includes two Appendixes. Appendix A presents a set of generic functional

performance requirements taxonomies which can be used to support these analyses, with suitable tailoring. Appendix B contains a set of exemplar SSI descriptions that can be used as a model for developing SSI concepts in Step 4.

PROCEDURES

The nine steps of the training system concept development procedures are presented in this section. An overview of the steps and their products is shown in Figure 1. For convenience, this Figure is repeated before the description of each step, with an indication of the step being performed. Each step description contains four parts, as follows:

1. The Objective of the step.
2. The Rationale for performing the step.
3. The Procedures to follow when performing the step.
4. The Product of the step--what results from performing the step.

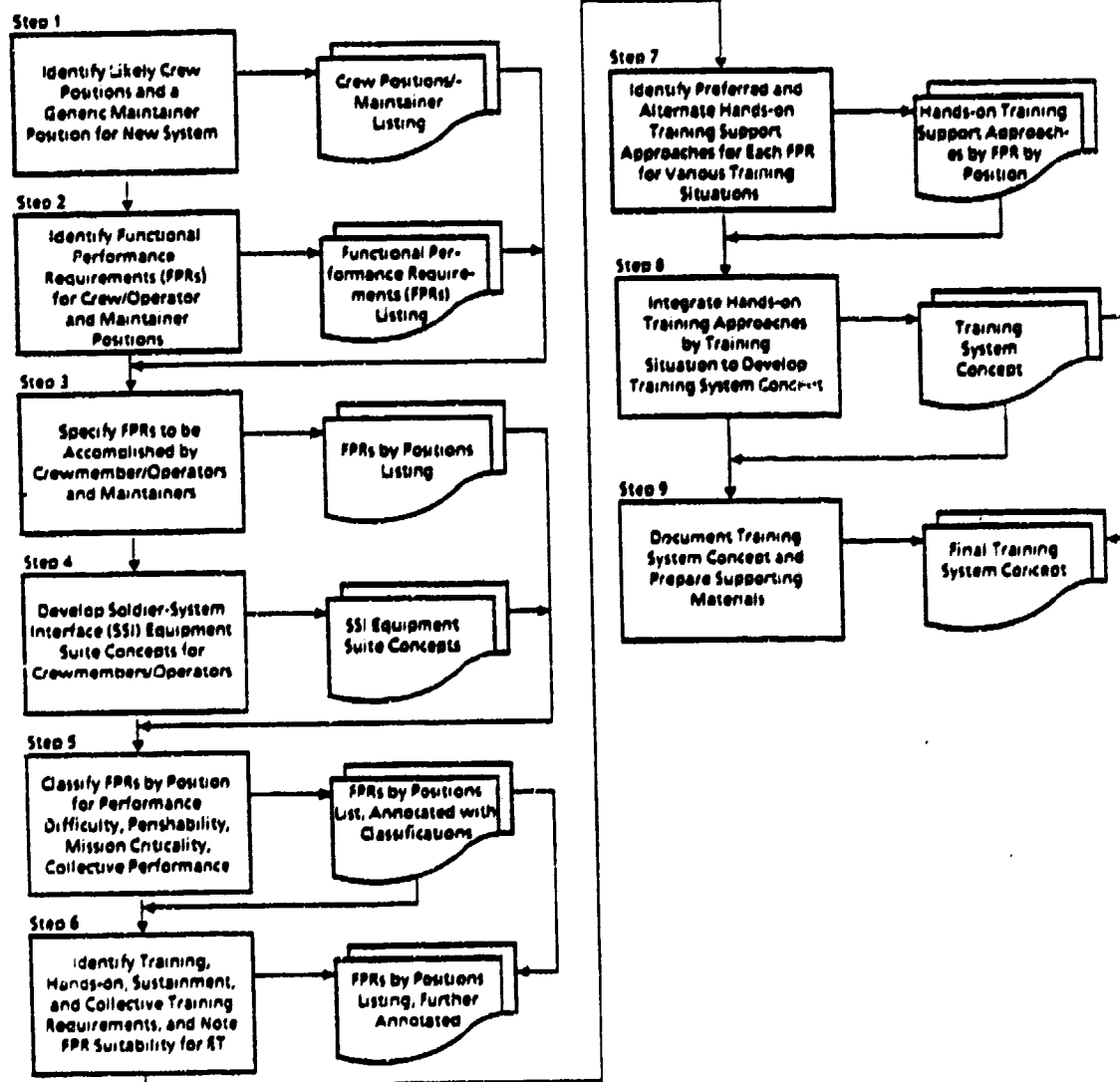
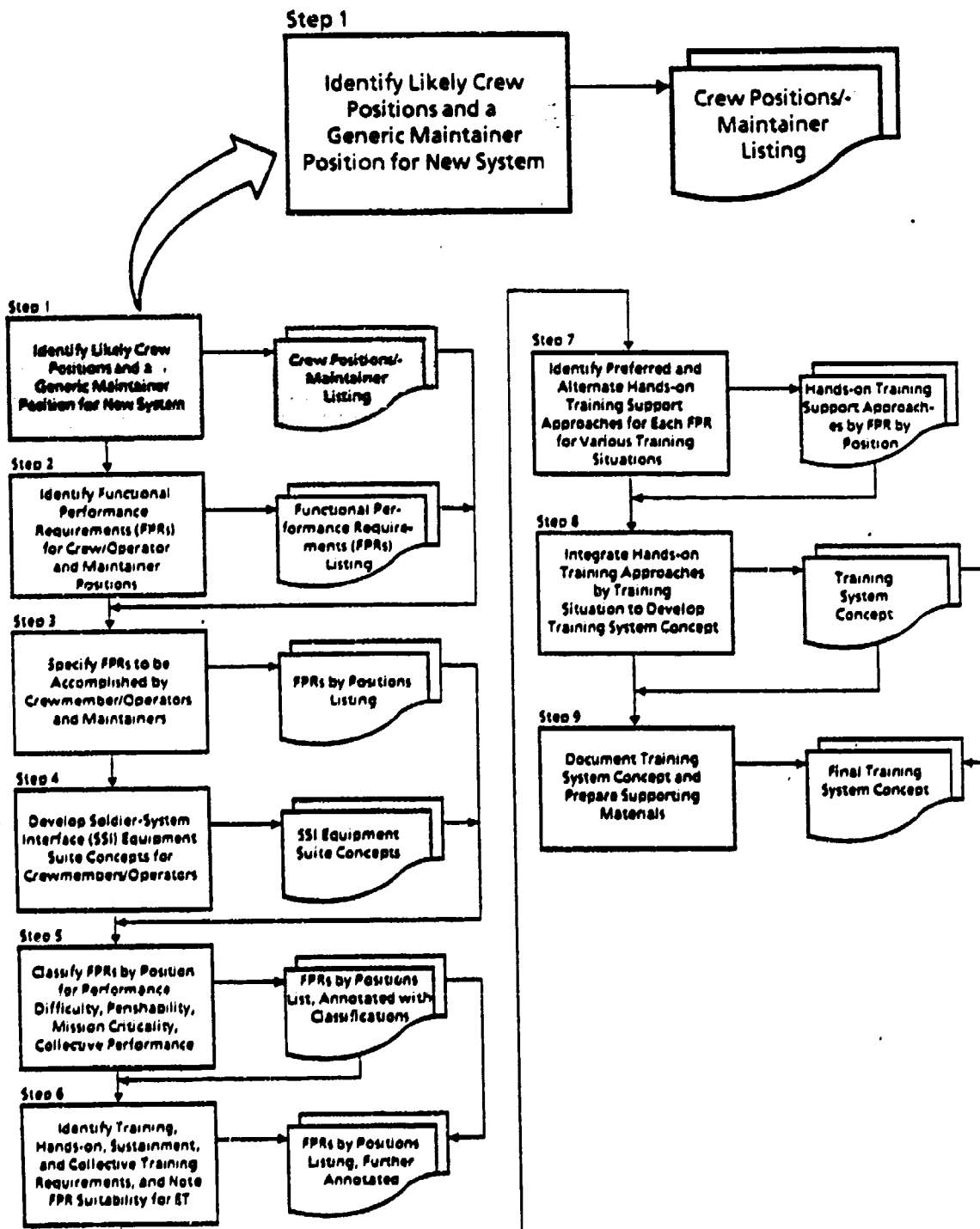


Figure 1. Procedures overview.



Step 1: Identify Likely Crew Positions and Maintainer
Positions for New System

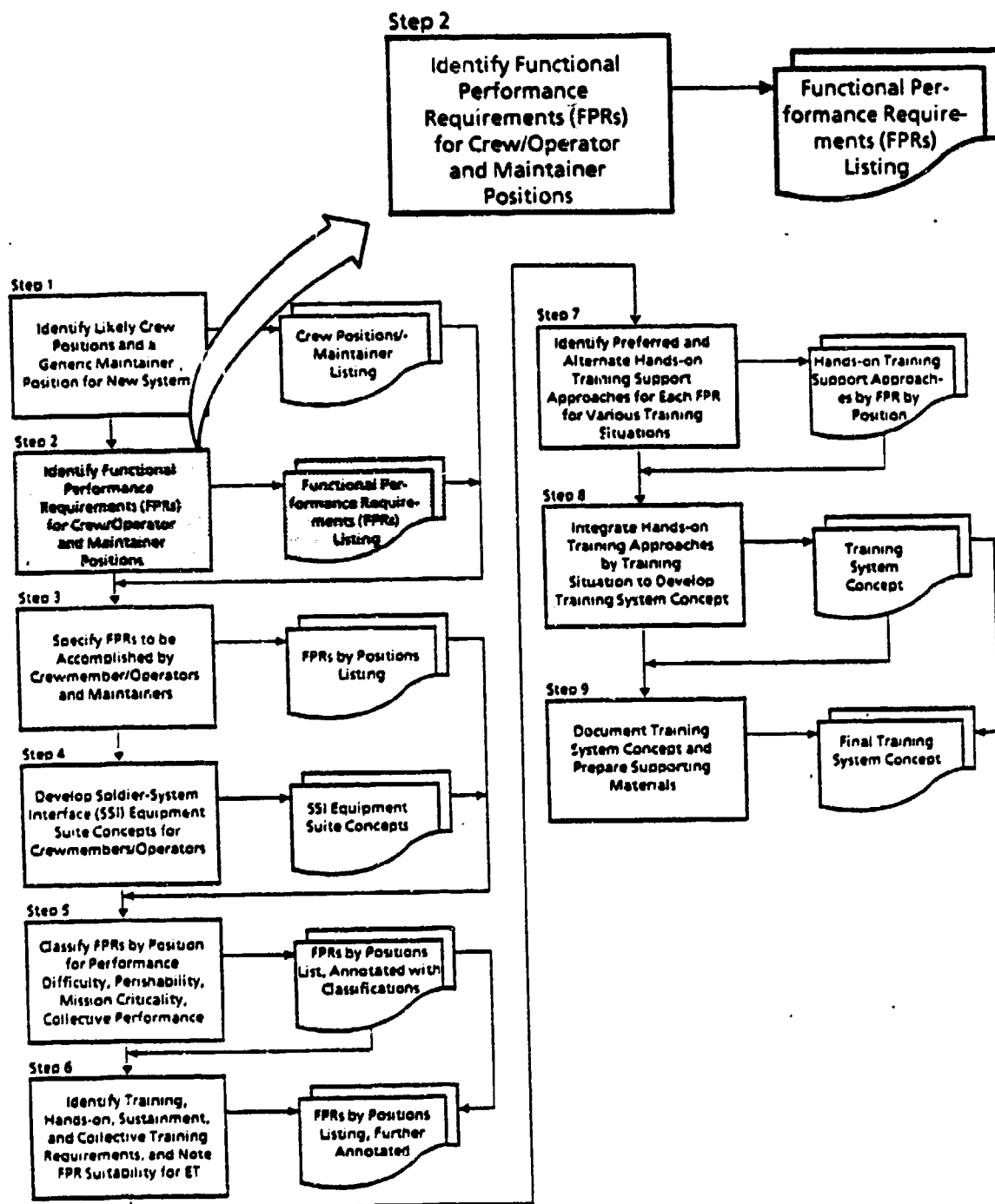
Objective: Specify and name the likely crew positions (e.g., commander, gunner, loader, driver for a tank; pilot, copilot, door gunner for a utility helicopter, etc.) for the new system, as well as a generic maintainer position or specific maintainer positions (if these have been identified).

Rationale: Knowing the likely crew and maintainer positions is necessary to develop a concept of the equipment that each crewmember/ maintainer is likely to deal with. This, in turn, aids in identifying the soldier-system interface (SSI) configurations of the new system. This information is needed to make training and performance requirements decisions and identify likely collective training requirements in later steps of the procedures.

Procedure:

1. Examine data on predecessor systems of similar types (good data sources are Field Manuals [FMs] and Technical Manuals [TMs] for predecessor systems), and identify typical crew positions for like-type systems.
2. Identify any planned changes in crew size based on assumptions, constraints, or technology.
3. Develop a list of likely crew positions for the new system. In making this list, you should consider:
 - a. Crew positions found in predecessor systems.
 - b. Planned reductions in crew size.
 - c. Possible reallocation of functions across crew systems (with respect to predecessor systems).
 - d. Differing roles of crewmembers due to possible reallocation of functions between the materiel system and soldiers.
4. Ensure that at least a "generic" maintainer position is included, in addition to crew positions. If maintainer position information is available, identify the specific maintainer positions that have been identified.

Product: A listing of crew positions, with descriptive titles, and maintainer positions, for considering system maintenance.



Step 2: Identify Functional Performance Requirements (FPRs)
for Crew or Operator and Maintainer Positions

Objective: Identify general functional areas of crewmember and maintainer performance which may require training.

Rationale: In order to estimate the characteristics of a training system, you must have an idea of what may need to be trained. At this point in the life cycle, only a general concept of what may have to be trained (functional performance requirements) is likely to be available. The functional performance requirements provide a basis for estimating likely training needs for the new system, in later steps of this analysis.

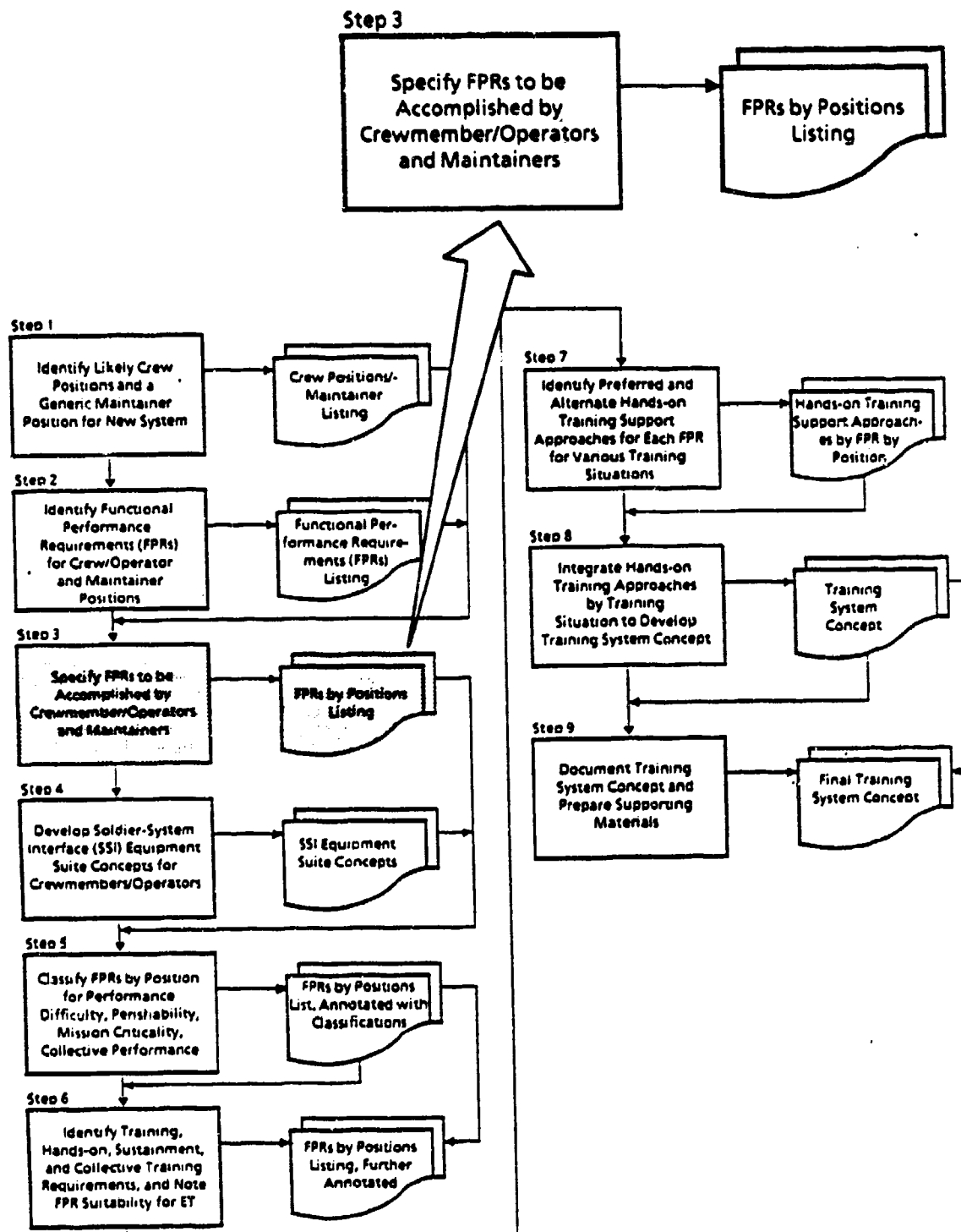
NOTE: Functional performance requirements should be considered from a soldier-performance point of view. They include tasks which must be performed by system operators and maintainers to enable the overall soldier-machine systems to achieve operational objectives.

Procedure: Develop a set of FPRs for the system, based on:

1. Knowledge of similar predecessor systems, along with available information about new functions, capabilities, etc. expected to be in the new system.
2. Task or functions data developed as a result of analyses to consider whether ET should be further considered for this system (Implementing Embedded Training (ET): Volume 2: ET as a System Alternative).
3. One of the functional performance requirements taxonomies included in Appendix A.

Ensure that at least a gross maintenance performance requirement is included--perhaps one requirement for preventive maintenance, and another for corrective maintenance and battle damage repair. If any information on more detailed maintainer functions is conveniently available, such information should be used in these analyses. Possible sources include maintainer functions of predecessor systems, ECA analyses, and HARDMAN studies.

Product: A functional performance requirements listing that covers both operator or crewmember and maintainer functional performance requirements.



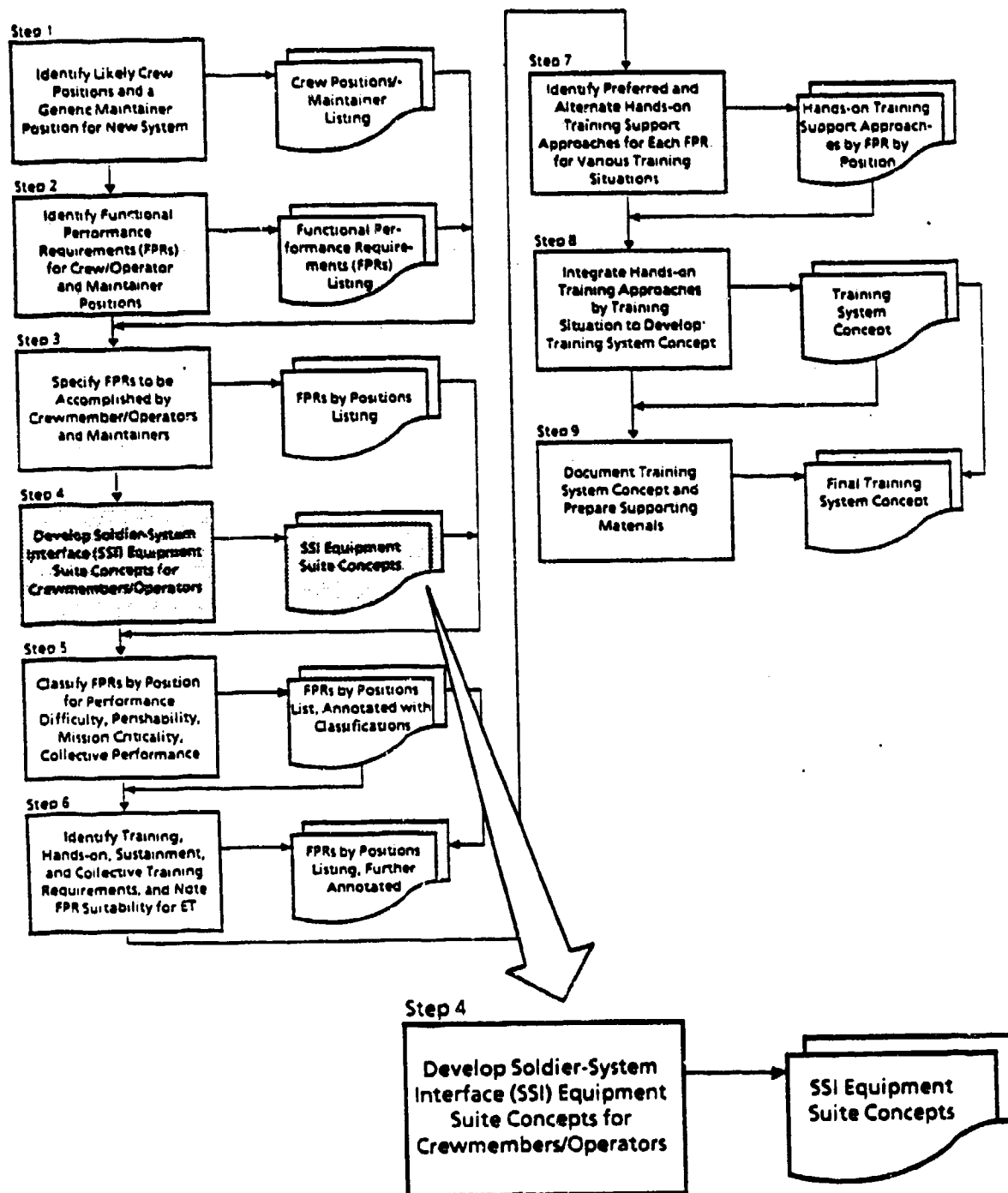
Step 3: Specify FPRs to be Accomplished by
Crewmembers or Operators and Maintainers

Objective: Identify which crewmember positions (or SSIs) and maintainers will be involved in performing each of the FPRs identified in Step 2.

Rationale: It is necessary to evaluate both individual and crew-collective performance and training in later steps. This step identifies FPRs which are only associated with individuals versus FPRs that are collective in nature.

Procedure: Identify the crewmembers or maintainer positions involved in performing each FPR. Then, annotate the FPR list, indicating each crewmember and/or maintainer involved in performing each requirement. Some useful data sources for this step are Army training and evaluation plans (ARTEP), soldier's manuals (SM), technical manuals (TM), any early comparability analysis data that may be available, analyses performed to investigate ET potential based on Implementing Embedded Training (ET): Volume 2: ET as a System Alternative, HARDMAN analysis results, and human factors engineering analysis (HFEA) data. Crewmembers should be identified as performing maintenance functions in many cases, since they commonly perform preventive maintenance checks and services (PMCS), and sometimes perform crew-level troubleshooting and repair. The maintainer FPRs should always be identified as performed by the "generic" maintainer position, or other specific maintainer positions that are identified.

Product: Annotations to the FPR list indicating the crewmembers (and maintainers) that are involved in performing each FPR.



Step 4: Develop Soldier-System Interface (SSI) Equipment Suite Concepts for Crewmembers or Operators

Objective: Identify probable equipment items or functional equipment elements present at each SSI, to assist in considering hands-on performance and training requirements for the FPRs.

Rationale: Identifying equipment items (or functional elements) present at each crew position (or SSI) helps in later steps in deciding on criticality, perishability, training requirements, and feasibility for embedding hands-on training for the FPRs.

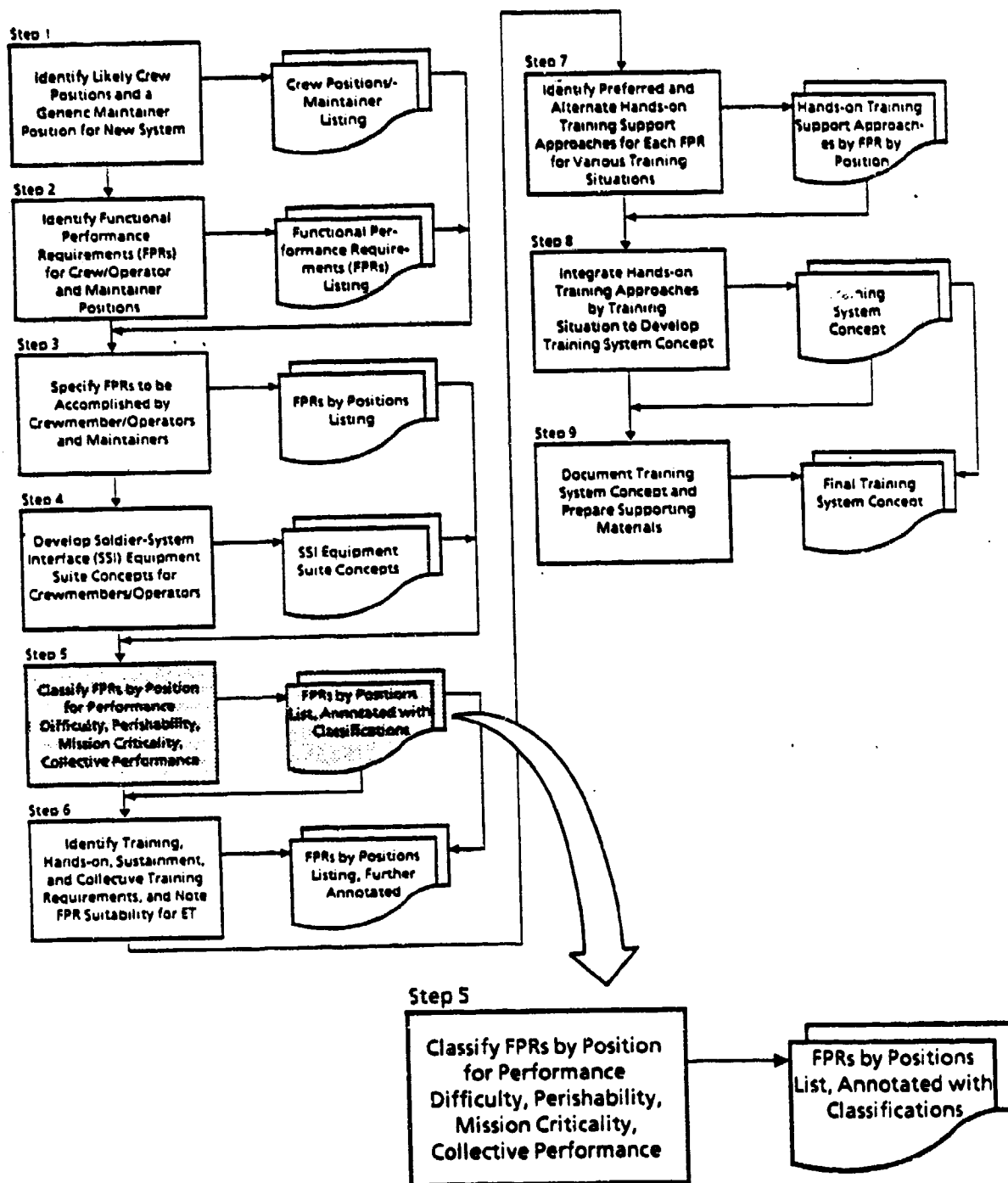
Procedure:

1. Identify equipment items or functional equipment elements, from selected predecessor systems, for each SSI. Multiple predecessor systems may be appropriate if functions from several systems are represented (e.g., if a composite baseline system is defined by HARDMAN or ECA). Useful data sources include TMs, SMs, and equipment descriptions.

NOTE: Be sure to include the maintainer SSI(s) in this step and later steps.

2. Remove from consideration any SSIs that are expected to be eliminated in the new system. You should also note equipment items that are no longer to be considered (e.g., no loader position is expected in a new tank due to providing an autoloader mechanism). This information may be available from mission area analysis (MAA) summaries, or from concept documents for the new system.
3. Identify any anticipated reallocation of equipment items or functional equipment elements across SSIs in new system (e.g., the tank gunner now selects ammunition and fuze, since the loader position is eliminated by providing an autoloader mechanism).
4. Identify and associate with specific SSIs any new equipment items or functional equipment elements that are to be incorporated in the new system (e.g., controls and displays for the autoloader mechanism).
5. Summarize SSI equipment element suites to assist in considering performance and training requirements in later steps of this procedure.

Product: SSI equipment suite descriptions, for all crew positions that will be in the new system. Appendix B contains some example SSI equipment suite descriptions.



Step 5: Classify FPRs by Position for Performance Difficulty,
Perishability, Mission Criticality, Collective
Performance

Objective: Perform classifications of each FPR on four characteristics that support decisions about training, sustainment, embedded training feasibility, and hands-on performance in Step 6.

Rationale: These classifications assist you in determining what sort of training requirements are likely to exist for each FPR, in identifying the feasibility or desirability for embedding training, in identifying needs for sustainment, and in selecting the FPRs to include in the training system concept.

Procedure: Consider each FPR in turn, for each involved crewmember or maintainer position, and make the four classifications listed below. Use the SSI equipment suite descriptions, and any available task or functional data from predecessor systems to help you make the decisions. Record each classification by FPR and crewmembers or maintainers involved in FPR performance.

1. Classify the FPR for each crewmember or maintainer as to the performance difficulty of the FPR, according to the following guidance. Record the classification for each crewmember and maintainer.

Classify performance difficulty as HIGH, if there are likely to be complex decisions or many highly variable psychomotor activities involved in performing the FPR, or if the FPR routinely requires near simultaneous performance of multiple tasks on a frequent basis.

Classify performance difficulty as MODERATE, if there are likely to be moderately complex decisions or some variable psychomotor activities involved in performing the FPR, and if the FPR requires near simultaneous performance of multiple tasks only occasionally.

Classify performance difficulty as LOW, if it is unlikely that performing the FPR will require complex decisions or variable psychomotor activities, and if the FPR seldom or never requires near simultaneous performance of multiple tasks.

2. Classify each FPR on its perishability once learned (the need for frequent reinforced practice to maintain proficiency), according to the following guidance. Record the classification for each crewmember and maintainer, by FPR.

Classify perishability as HIGH if reinforced practice is needed more than once per week to maintain proficiency on the FPR to standard.

Classify perishability as MODERATE if reinforced practice is needed more than twice per month to maintain proficiency on the FPR to standard.

Classify perishability as LOW if reinforced practice is needed no more than once per month to maintain proficiency on the FPR to standard.

3. Classify each FPR on its criticality to mission success, according to the following guidance. Record the classification of criticality for each crewmember and maintainer, by FPR.

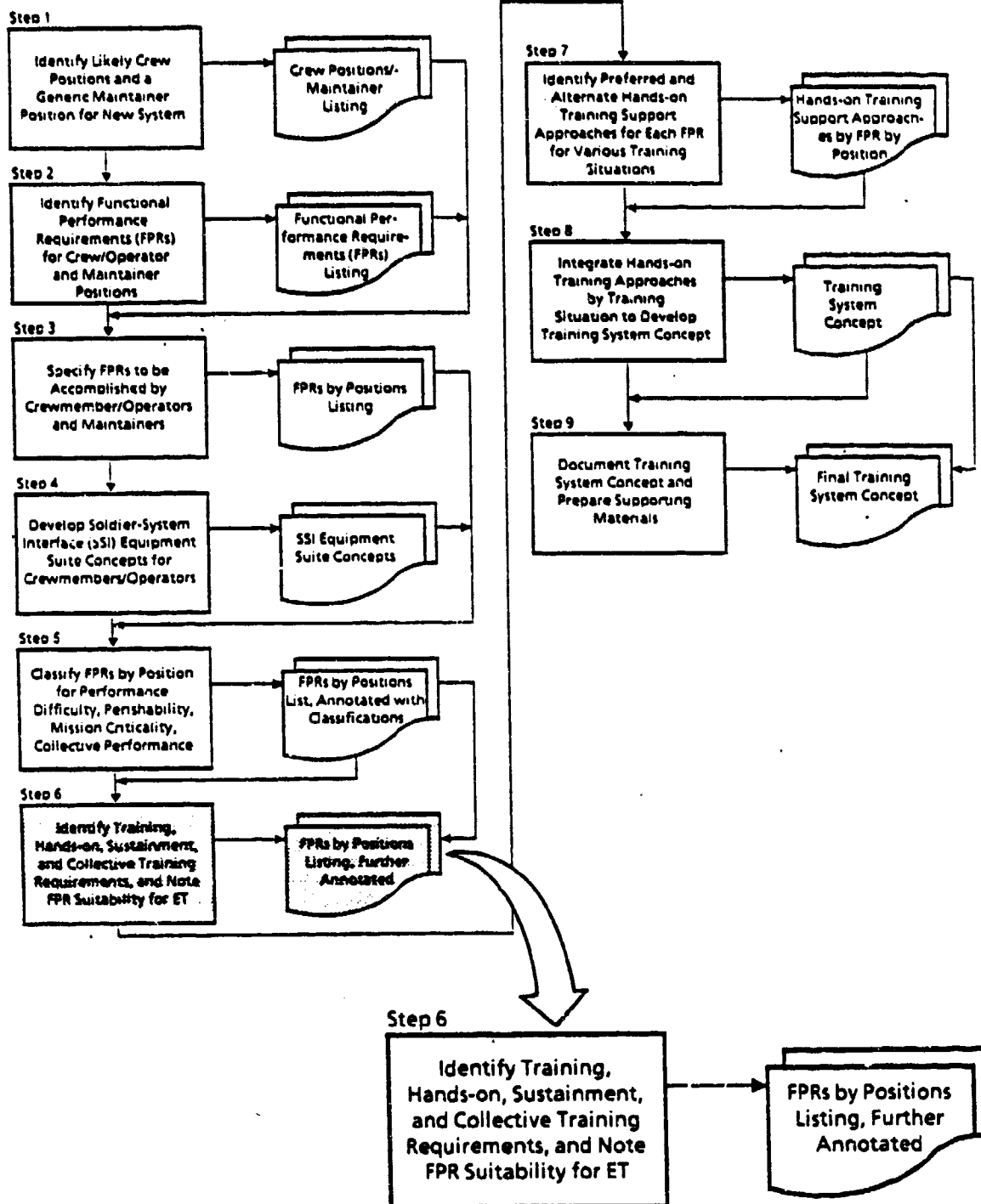
Classify mission criticality as HIGH, if there is more than a 50 percent chance that a mission may fail if the FPR is not performed to standard by the crewmember or maintainer.

Classify mission criticality as MODERATE, if there is between a 25 percent and a 50 percent chance that a mission may fail if the FPR is not performed to standard by the crewmember or maintainer.

Classify mission criticality as LOW, if there is less than a 25 percent chance that a mission may fail if the FPR is not performed to standard by the crewmember or maintainer.

4. Classify whether performing the FPR involves hands-on use of equipment as a primary activity of the crewmember or maintainer. Record this as a YES or NO decision for each crewmember and maintainer.

Product: Classifications for each involved crewmember and maintainer on each of the four characteristics, for each FPR. The classifications should be entered as annotations to the FPR list.



Step 6: Identify Training, Hands-on, Sustainment, and Collective Training Requirements, and Note FPR Suitability for ET

Objective: Apply selection criteria to each functional performance requirement to identify those that:

1. Require training.
2. Require sustainment.
3. Are candidates for ET.
4. Require collective performance (and, therefore, collective training).

Rationale: This step identifies categories of FPRs that will need to be considered in different types of training situations, in Step 7.

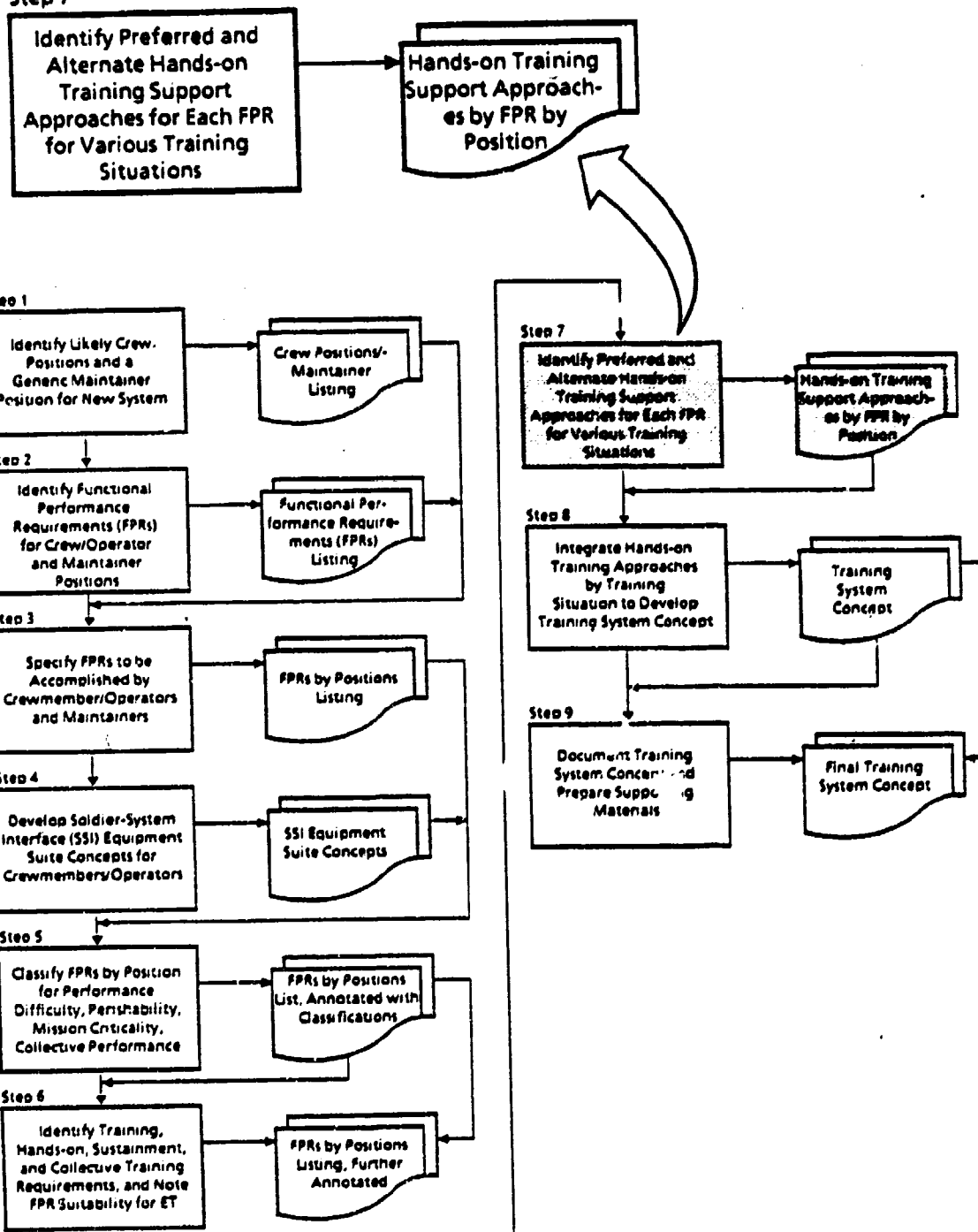
Procedure: Examine the classifications made in Step 5, on the basis of crewmembers or maintainers involved in performing each FPR, and make and record the following decisions for each crewmember or maintainer and FPR:

1. If mission criticality is MODERATE or HIGH or performance difficulty is MODERATE or HIGH for any crewmember, then initial (e.g., institutional) training is required for the FPR, at least for the crewmembers that satisfy this criterion.
2. If mission criticality is MODERATE or HIGH or perishability is MODERATE or HIGH for any crewmember, then sustainment is required for the FPR, and ET may be a candidate for the FPR in question, at least for that crewmember.
3. If more than one crewmember is involved in performing an FPR, then collective training and sustainment is required for that FPR.

Note that multiple classification is perfectly acceptable, and is expected for many FPRs--an FPR can require initial training, sustainment, collective training, and be an ET candidate.

Product: Recorded decisions about each of the classification areas. These decisions should be added as annotations to the FPR list.

Step 7



Step 7: Identify Preferred and Alternate Hands-on Training Support Approaches for Each FPR for Various Training Situations

Objective: Identify preferred and alternate hands-on training support approaches for each FPR, for a variety of training situations (institutional training, new equipment training [NET], and unit sustainment training).

NOTE: For purposes of developing the training system concept, sustainment training is considered to include cross-training for other crew positions on the same system to which a soldier is assigned and skill upgrade training conducted in the unit, in addition to sustainment training which maintains skills acquired in initial institutional training.

Rationale: To develop the training system concept, it is necessary to identify hands-on training support approaches and alternatives for each FPR and each training situation (the approaches for all FPRs will be considered jointly in Step 8).

- Procedure:**
1. Obtain a list of the FPRs (by crewmember or maintainer), with notations about the decisions made in Step 6.
 2. Disregard any FPRs for which neither initial training nor sustainment is required.
 3. Using the flowchart in Figure 2, identify and record preferred and alternative hands-on support approaches for each training situation (institutional, unit-NET, unit-sustainment) for each FPR.

NOTE: An explanation of abbreviations used in Figure 2 is presented in Table 1.

Follow the appropriate decision paths in the flowchart for each FPR and crewmember or maintainer. For example, if you were considering an FPR for a crew position that required both initial training and sustainment, you would follow at least three of the paths through the first page of the flowchart: the individual training-institutional path for initial training; the individual training-NET path for NET, and the individual training-sustainment path for sustainment. You should consider both individual training and collective training, as applicable. If collective performance or training has been specified (in Step 6) for an FPR, follow the collective-training paths in the flowchart to find recommendations for hands-on

collective training approaches. Record the recommended hands-on training support approaches for each training situation for each FPR and crewmember or maintainer.

Product: Identification of hands-on training support approaches for each training situation, for each FPR and crewmember or maintainer.

Table 1

Explanation of Abbreviations in Figure 2

Abbreviation	Explanation
Positional SAD	A Stand-Alone Training Device (SAD) used to support hands-on training for a single crew position
AET - no Embedded	Training using the actual equipment without Embedded Training capabilities
Exercise/OPTempo	Conventional, go-to-the-field, exercise-based training
Embedded	Embedded Training capabilities incorporated into operational systems
SIMNET	Utilization of SIMulation NETwork (SIMNET) approach to support hands-on training
Crew/team SAD	A SAD used to support training for a crew or subset of crewmembers for a system
MTD	Maintenance Training Device (MTD) used to support hands-on training for maintainers
BIT/BITE/PITE	Built-in Test (BIT), Built-in Test Equipment (BITE), Plug-in Test Equipment (PITE)
OJT	On-the-job training

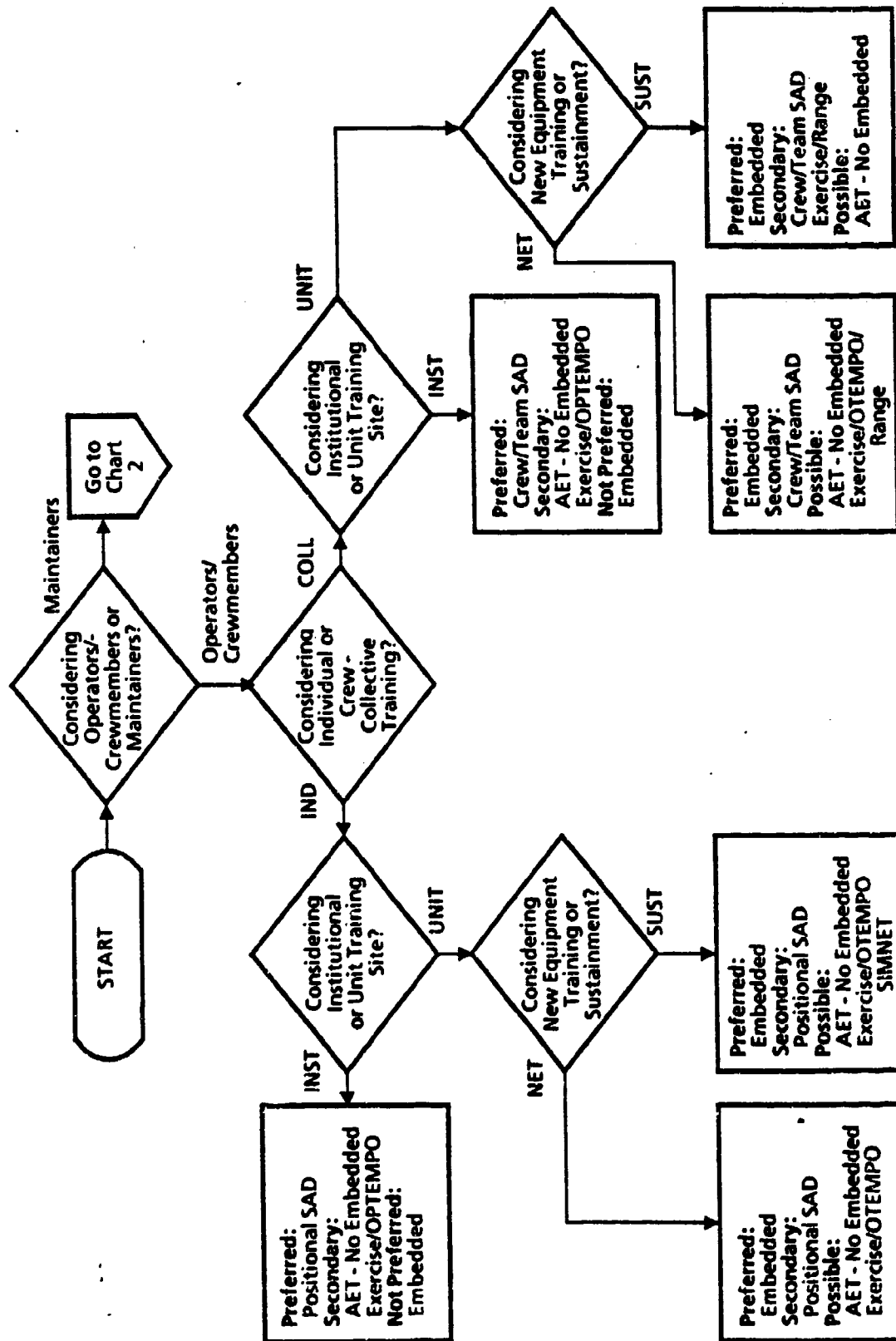


Figure 2. Training system concept development guidance.

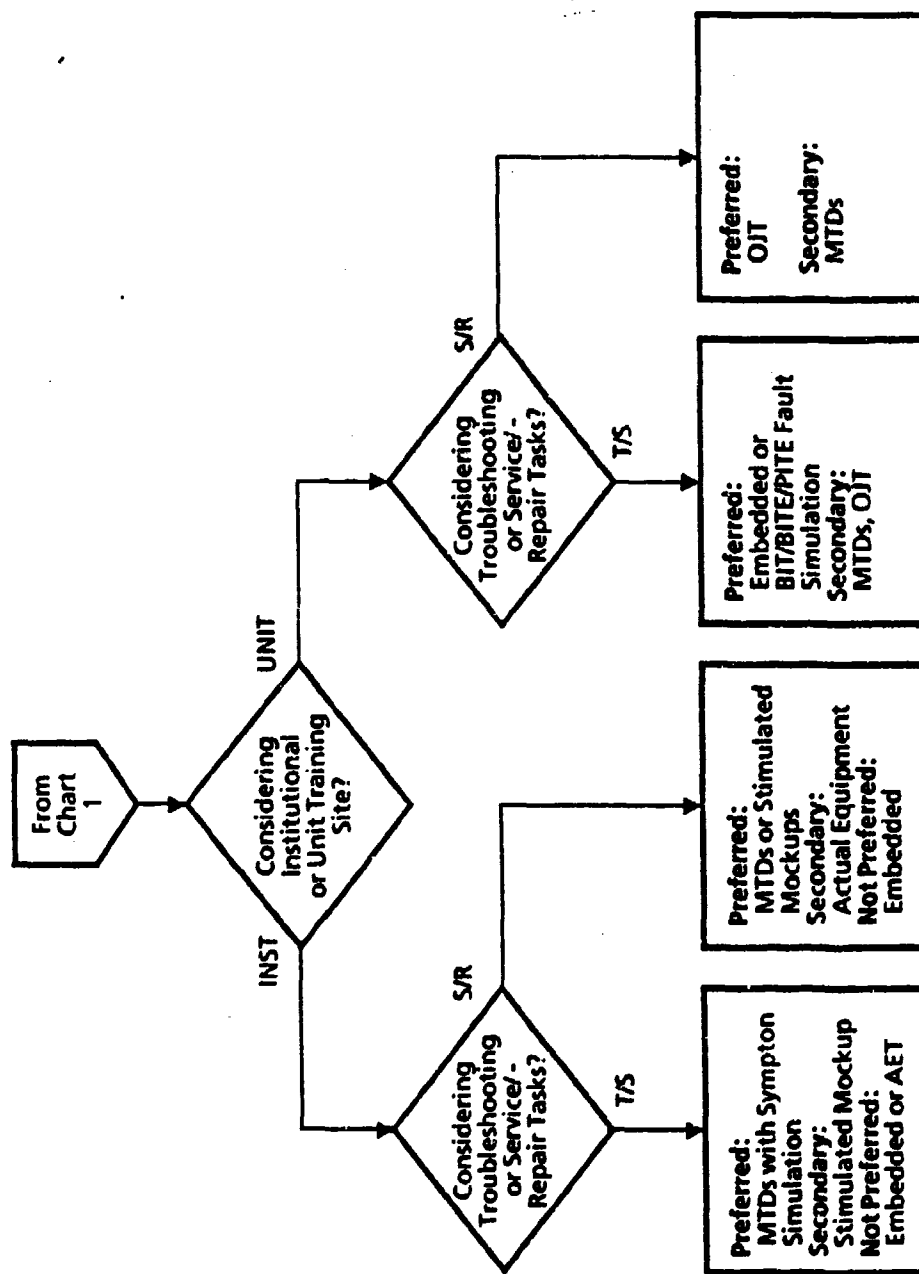
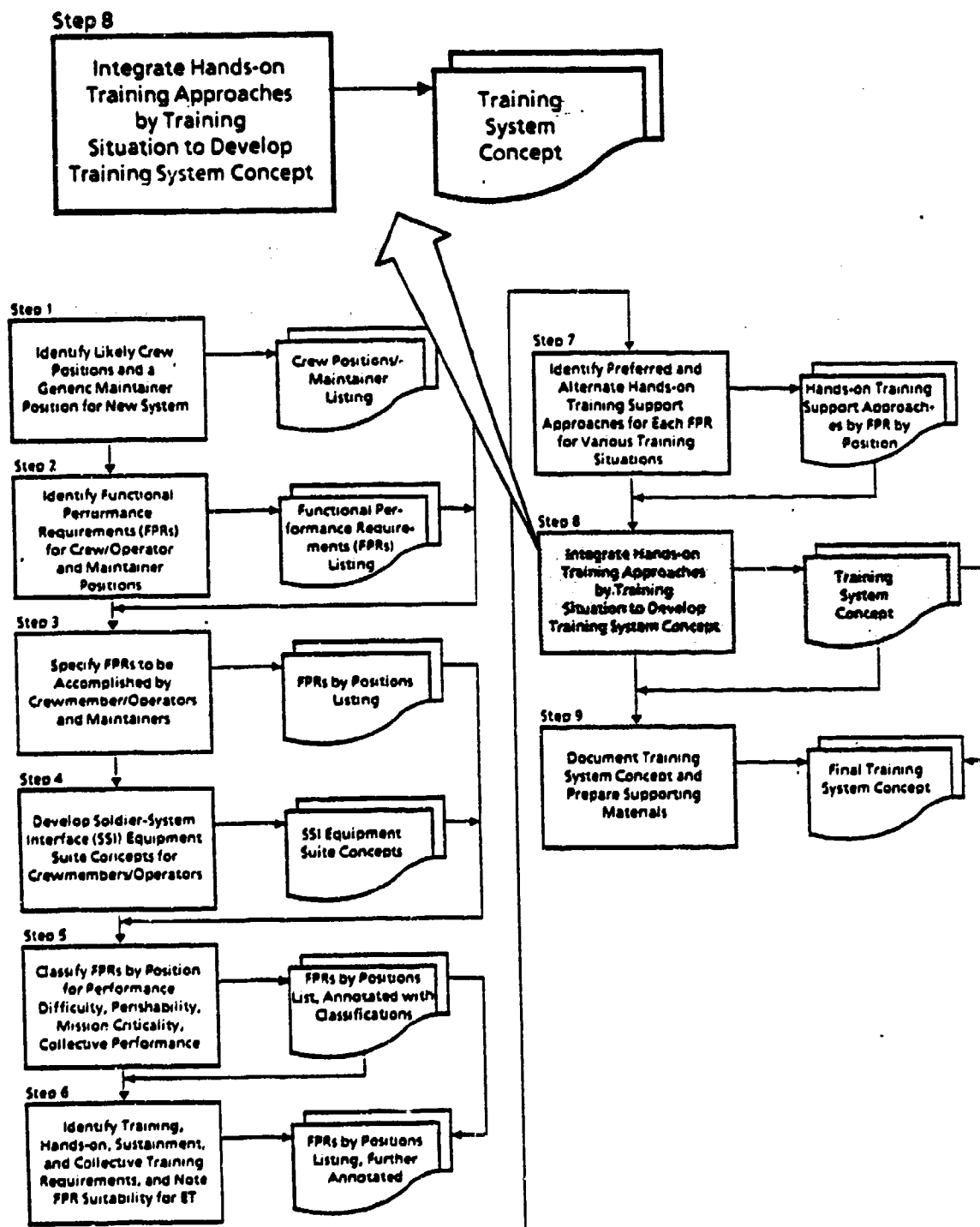


Figure 2. Training system concept development guidance (concluded).



Step 8: Integrate Hands-on Training Approaches by Training Situation to Develop Training System Concept

Objective: Evaluate identified hands-on training alternatives for all FPRs to be trained in each training situation, to derive a joint approach or mix for hands-on training support alternatives for each situation.

Rationale: Recommended alternatives may differ across FPRs for a given training situation. This step enables you to consider and trade off mixed support approaches for each training situation, to develop a concept for how hands-on training will be supported overall in the training system.

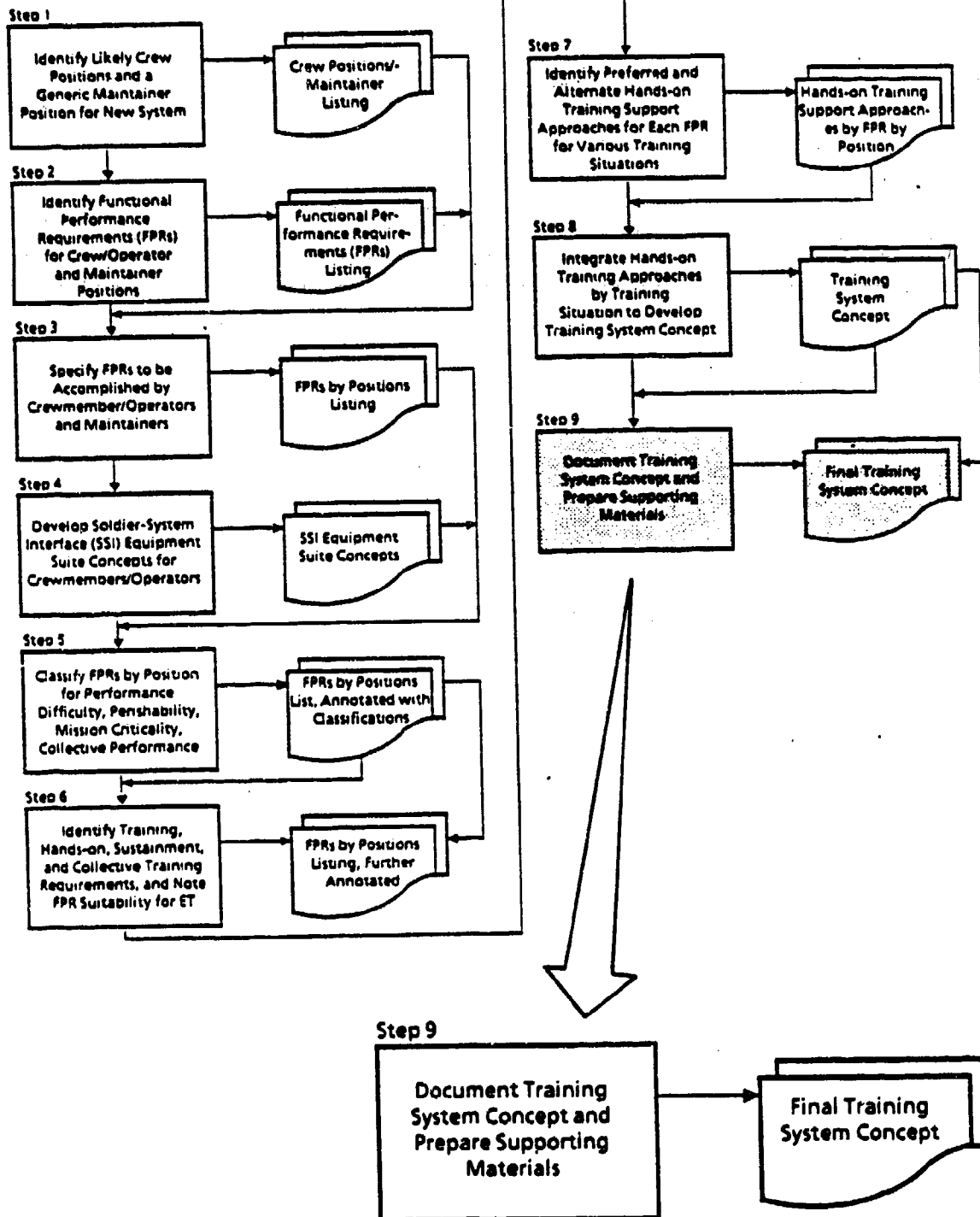
- Procedure:
1. Obtain a list of the FPRs to be trained in each training situation (institutional, unit-NET, unit sustainment), for operators and maintainers separately, annotated with the hands-on training support approaches you identified in Step 7.
 2. Examine the recommended hands-on training support approaches across the FPRs for each training situation in the following list:
 - a. Initial institutional training for individual crewmembers or operators.
 - b. Unit-NET training for individual crewmembers or operators.
 - c. Unit-sustainment training for individual crewmembers or operators.
 - d. Collective institutional training for crewmembers or operators.
 - e. Collective unit-NET training for crewmembers or operators.
 - f. Collective unit-sustainment training for crewmembers or operators;
 - g. Initial institutional training for maintainers (including transition training for newly introduced systems).
 - h. Unit sustainment training for maintainers.
 3. If the hands-on training support recommendations differ among the FPRs being considered for a given training

situation, you may want to specify a mixed support concept (more than one hands-on training support approach) for supporting hands-on training in the situation under consideration.

4. Record the hands-on training support approaches (either "pure" or "mixed") by training situation.

Product:

A list of preferred and alternative hands-on training approaches and recommended mixes, by training situation. This is the training system concept produced by these procedures.



Step 9: Document Training System Concept
and Prepare Supporting Materials

Objective: Document the training system concept in a simple and easily understood format. Also, provide supporting documentation for the training system concept, to establish an audit trail for the decisions made in these procedures.

Rationale: Presenting the training system concept in a simple and straightforward manner enables analysts and managers to comprehend the concept readily, and simplifies communication and understanding of the training system concept.

Procedure: Record the hands-on training support approaches for each training situation (developed in Step 8) in a matrix format similar to that shown in Figure 3. If a mixed approach is recommended for a particular training situation, make multiple entries in rows of the matrix, indicating the desirable mix of approaches. Use "X's" in matrix cells to indicate that a particular hands-on training support approach is appropriate for a given training situation. If you wish to indicate alternative approaches, several entries can be made for each training situation (one line per entry). Use of some coding (e.g., "P" for a preferred approach and "A" for an alternate) is recommended if this is done. Support the matrix summary with a listing of hands-on training support recommendations by functional performance requirement, for each training situation separately, to show the derivation of the recommendations presented in the matrix.

Product: The documented training system concept.

NOTE: The training system concept developed in these procedures should be considered preliminary. As the materiel system and its associated tasks, doctrine, and tactical use evolve, much additional data that impact the training system will become available. Later versions of "how to train" will have to take this information into account. The concept developed here should be thought of as "setting the stage" for initial studies of training and generation of requirements for the training system that will eventually be developed.

Sample Training System Concept Presentation Matrix

Training Situation	Hands-On Training Support Alternatives					
	ET	Pos SAD	Crew SAD	Act. Eq.	MTD	OJT
INSTITUTIONAL TRAINING (Initial Training)						
Crewmember/Operator						
Individual						
Collective						
Maintainer (Incl. New Equipment)						
UNIT TRAINING						
New Equipment Training						
Crewmember/Operator						
Individual						
Collective						
SUSTAINMENT TRAINING						
Crewmember/Operator						
Individual						
Collective						
Maintainer						

Figure 3. Example summary matrix for a training system concept.

APPENDIX A

EXAMPLE FUNCTIONAL PERFORMANCE REQUIREMENTS (FPRs)
TAXONOMIES FOR MATERIEL SYSTEMS

The taxonomies of operator Functional Performance Requirements (FPRs) in this Appendix are not intended to cover all possible types of systems. They are provided as a convenient starting point for considering FPRs for a number of types of major materiel systems for which training system concepts may need to be developed.

**Close Combat Heavy (Infantry)
Infantry Fighting Vehicles**

Plan and prepare mission

Drive vehicle

Navigate

Communicate

Detect/locate/acquire target

Attack target

Defend against attack

Perform reconnaissance

Call for fire support

Transport combat troops and supplies

Perform post-mission tasks

Compensate for equipment malfunctions and emergencies

**Close Combat Light (Infantry)
Antitank Vehicles**

Plan and prepare mission

Drive vehicle

Navigate

Communicate

Detect/locate/acquire target

Attack target

Defend against attack

Perform reconnaissance

Call for fire support

Perform post-mission tasks

Compensate for equipment malfunctions and emergencies

Close Combat Light (Infantry)
Man-portable Weapons

Conduct pre-operational inspection
Prepare weapon for firing
Emplace weapon/Get into firing position
Detect/locate/acquire targets
Fire weapon
Perform post-firing tasks
Clear/recover from misfire

Close Combat Light
Medium Antitank Weapons

Conduct pre-operational inspection
Prepare weapon for firing
Emplace weapon/Get into firing position
Detect/locate/acquire targets
Fire weapon
Clear/recover from misfire
Perform post-firing tasks

Close Combat Light
Heavy Antitank Weapons

Conduct pre-operational inspection
Prepare weapon for firing
Emplace weapon/Get into firing position
Detect/locate/acquire targets
Fire weapon
Perform post-firing tasks
Clear/recover from misfire

Close Combat Heavy (Armor)
Tanks

Plan and prepare mission
Drive vehicle
Navigate
Communicate
Detect/locate/acquire target
Attack target
Defend against attack
Perform reconnaissance
Call for fire support
Perform post-mission tasks
Compensate for equipment malfunctions and emergencies ..

Close Combat Heavy (Armor)
Cavalry Fighting Vehicles

Plan and prepare mission
Drive vehicle
Navigate
Communicate
Detect/locate/acquire target
Attack target
Defend against attack
Perform post-mission tasks
Perform reconnaissance
Call for fire support
Compensate for equipment malfunctions and emergencies
Transport combat troops

Fire Support (Field Artillery)
Medium Range Missiles

Prepare for march order
Move to firing point
Navigate
Communicate
Emplace system
Prepare weapon for firing
Fire weapon
Conduct post-firing inspections
Execute "failure to fire" procedures
Compensate for equipment malfunctions and emergencies
Perform emergency destruction of warhead
Displace system

Fire Support (Field Artillery)
Long Range Missiles

Prepare for march order

Move to firing point

Navigate

Communicate

Emplace system

Prepare weapon for firing

Fire weapon

Conduct post-firing inspections

Execute "failure to fire" procedures

Compensate for equipment malfunctions and emergencies

Perform emergency destruction of warhead

Displace system

Fire Support (Field Artillery)
Towed Howitzers

Prepare for march order

Drive/move cannon

Navigate

Emplace cannon

Displace cannon

Prepare cannon for firing

Fire cannon

Fire cannon at direct fire target

Navigate

Communicate

Defend against attack

Compensate for equipment malfunctions and emergencies

Perform post-mission tasks

Fire Support (Field Artillery)
Self-Propelled Howitzers

Prepare for march order

Drive/move cannon

Navigate

Emplace cannon

Displace cannon

Prepare cannon for firing

Fire cannon

Fire cannon at direct fire targets

Fire crew served weapons

Navigate

Communicate

Defend against attack

Displace system

Compensate for equipment malfunctions and emergencies

Perform post-mission tasks

Fire Support (Field Artillery)
Rocket Systems

Prepare for march order

Move to firing point

Navigate

Communicate

Emplace system

Prepare weapon for firing

Fire weapon

Conduct post-firing inspections

Execute "failure to fire" procedures

Compensate for equipment malfunctions and emergencies

Perform emergency destruction of warhead

Displace system

Fire Support (Field Artillery)
Resupply Vehicles

Prepare for march order

Drive/move to weapon site

Drive/move to supply stores site

Navigate

Load/unload stores

Communicate

Defend against attack

Compensate for equipment malfunctions and emergencies

Perform post-mission tasks

Air Defense
Gun Systems

Prepare for march order

Move vehicle

Navigate

Emplace system

Prepare weapon for engagement

Load/reload weapon

Detect/locate/acquire target

Engage aircraft targets

Engage ground targets

Communicate

Defend against attack

Displace system

Perform post-mission tasks

Compensate for equipment malfunctions and emergencies

Air Defense
Line of Sight Missile Systems

Prepare for march order

Move vehicle

Navigate

Emplace system

Prepare weapon for engagement

Detect/locate/acquire target

Engage aircraft targets

Navigate

Communicate

Reload missile launchers

Replenish missile load

Defend against attack

Displace system

Perform post-mission tasks

Compensate for equipment malfunctions and emergencies

Air Defense
Non-Line of Sight Systems

Prepare for march order

Move vehicle

Navigate

Emplace system

Prepare weapon for engagement

Detect/locate/acquire target

Engage aircraft targets

Engage ground targets

Communicate

Reload missile launchers

Replenish missile load

Defend against attack

Displace system

Perform post-mission tasks

Compensate for equipment malfunctions and emergencies

Air Defense
Man-Portable Air Defense Systems

Conduct pre-operational inspection

Prepare weapon for firing

Emplace weapon/Get into firing position

Detect/locate/acquire target

Fire weapon

Clear/recover from misfire

Perform post-firing tasks

Aviation

Attack Helicopters

Plan and prepare for mission

Taxi and takeoff

Fly aircraft to/from mission area

Fly during night conditions

Fly during weather conditions

Manage weight and balance

Navigate

Communicate

Approach and land aircraft

Perform after-landing tasks

Compensate for in-flight equipment malfunctions and emergencies

Detect/locate/acquire targets

Attack target

Defend against ground attack

Defend against air attack

Perform reconnaissance

Call for fire support

Perform post-mission tasks

Aviation
Cargo Helicopters

Plan and prepare for mission

Taxi and takeoff

Fly aircraft to/from mission area

Fly during night conditions

Fly during weather conditions

Manage weight and balance

Navigate

Communicate

Approach and land aircraft

Perform after-landing tasks

Compensate for in-flight equipment malfunctions and emergencies

Defend against ground attack

Defend against air attack

Load/unload internal loads

Raise/lower external loads

Perform paradrop

Rappel troops

Call for fire support

Perform post-mission tasks

Aviation
Utility Helicopters

Plan and prepare for mission

Taxi and takeoff

Fly aircraft to/from mission area

Fly during night conditions

Fly during weather conditions

Manage weight and balance

Navigate

Communicate

Approach and land aircraft

Perform after-landing tasks

Compensate for in-flight equipment malfunctions and emergencies

Detect/locate/acquire targets

Attack target

Defend against ground attack

Defend against air attack

Load/unload internal loads

Raise/lower external loads

Perform paradrop

Rappel troops

Perform reconnaissance

Call for fire support

Perform post-mission tasks

Aviation
Scout Helicopters

Plan and prepare for mission

Taxi and takeoff

Fly aircraft to/from mission area

Fly during night conditions

Fly during weather conditions

Navigate

Communicate

Approach and land aircraft

Perform after-landing tasks

Compensate for in-flight equipment malfunctions and emergencies

Detect/locate/acquire targets

Attack target

Defend against ground attack

Defend against air attack

Perform reconnaissance

Call for fire support

Perform post-mission tasks

Aviation

Fixed Wing Aircraft

Plan and prepare for mission

Taxi and takeoff

Fly aircraft to/from mission area

Fly during night conditions

Fly during weather conditions

Navigate

Communicate

Approach and land aircraft

Perform after-landing tasks

Compensate for in-flight equipment malfunctions and emergencies

Manage weight and balance

Defend against ground attack

Defend against air attack

Perform paradrop

Perform reconnaissance

Perform post-mission tasks

Aviation
V/STOL Aircraft

Plan and prepare for mission

Taxi and takeoff

Fly aircraft to/from mission area

Fly during night conditions

Fly during weather conditions

Navigate

Communicate

Approach and land aircraft

Transition between vertical and forward modes

Perform after-landing tasks

Compensate for in-flight equipment malfunctions and emergencies

Acquire targets

Attack target

Manage weight and balance

Defend against ground attack

Defend against air attack

Raise/lower internal loads

Perform paradrop

Rappel troops

Perform reconnaissance

Call for fire support

Perform post-mission tasks

Combat Service Support
Light Cargo Trucks

Plan and prepare mission

Prepare load

Drive vehicle

Navigate

Defend against attack

Compensate for equipment malfunctions and emergencies

Load/unload vehicle

Perform post-mission procedures

Combat Service Support
Heavy Cargo Trucks

Plan and prepare mission

Prepare load

Drive vehicle

Navigate

Defend against attack

Compensate for equipment malfunctions and emergencies

Load/unload vehicle

Perform post-mission procedures

Combat Service Support
Recovery Vehicles

Plan and prepare mission
Drive vehicle to recovery site
Navigate
Position and prepare recovery vehicle
Prepare system to be recovered
Perform recovery
Perform post-recovery procedures
Tow disabled vehicle/equipment
Perform post-mission procedures

Intelligence and Electronic Warfare
Interpretation and Analysis Systems

Identify key environmental features
Identify key elements of threat force
Identify/select routes
Identify hazards to movement
Identify early warning of enemy threat
Predict enemy vulnerability/strength
Identify targets
Report map changes; update sitmap
Prepare briefings
Fuse multi-source intelligence

Command, Control, Communications
Fire Control Systems

Represent battlefield conditions

Acquire targets

Gather and interpret target information

Predict target behavior

Select and order targets

Select friendly units to engage targets

Manage weapon functions

Compensate for equipment malfunctions and emergencies

Communicate

Prepare briefings

Command, Control, Communications
Battlefield Management Systems

Represent battlefield conditions

Represent status of forces

Project battlefield operations

Project weather conditions

Select and order targets

Manage weapon functions

Plan personnel

Plan logistics

Select friendly units to engage targets

Control friendly forces for offense and defense

Prepare briefings

**Command, Control, Communications
Communication Systems**

Assemble equipment and antennas

Establish/enter communications network

Transmit and receive messages

Encode/decode messages

Apply transmission/reception security procedures

Apply anti-jamming procedures

Route information

**Combat Support--Engineering and Mine Warfare
Demolition Detection Equipment**

Plan and prepare mission

Operate detection equipment

Mark danger areas

Perform post-mission operations

**Combat Support--Engineering and Mine Warfare
Combat Engineer Vehicles**

Plan and prepare mission

Drive vehicle to obstacle removal/breaching site

Navigate

Plan exact approach to accomplish mission

Prepare system hardware for obstacle removal/breaching

Remove/breach obstacle

Perform post-removal/breachment procedures

Compensate for equipment malfunctions and emergencies

Perform post-mission procedures

Combat Support--Engineering and Mine Warfare
Recovery Vehicles

Plan and prepare mission

Drive vehicle to recovery site

Navigate

Position and prepare recovery vehicle

Position and prepare system to be recovered

Perform recovery

Perform post-recovery procedures

Perform post-mission procedures

Combat Support--Engineering and Mine Warfare
Bridging Equipment

Plan and prepare mission

Prepare bridge site

Excavate foundations

Construct bridge abutments

Construct bridge span

Construct/assemble bridge

Prepare bridge and transporter for launching

Launch bridge

Connect bridge

Recover bridge

Disassemble bridge

Perform post-mission tasks

Combat Support--Engineering and Mine Warfare
Mines and Explosives

Plan mission

Conduct pre-operational inspection

Transport explosive or mine

Emplace explosive or mine

Prepare diagram of layout

Arm weapon

Perform post-mission tasks

APPENDIX B

EXAMPLE SOLDIER-SYSTEM INTERFACE (SSI)
EQUIPMENT SUITE DESCRIPTIONS

The examples provided in this Appendix are not intended to cover all possible crew positions for all types of systems. They are simply samples provided to indicate the type of crew position SSI description that has been found to be helpful in thinking about and classifying operator functional performance requirements in the context of deriving the training system concept.

SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Driver

- Driving controls (directional, transmission, brake, accelerator)
- Vehicle subsystems status and monitoring displays (fuel gauge, caution and warning panel, engine instruments, etc.)
- Vehicle subsystems controls (engine, electrical, hydraulic, lights, etc.)
- External vision
 - o Direct view/vision blocks/optical sight
 - o Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary
- Intercom controls
- Tactical situation display (possible)
- Navigation system - if used by driver
 - o Map Display
 - o Inertial position/azimuth
 - o Map/compass backup
- Maintenance/diagnostics displays and controls
 - o BIT/BITE
- APU controls and displays
- Environmental controls and displays
- Smoke generator controls
- Embedded Training display(s)
- Refuel controls
- Mission-module relevant controls and displays (engineer and logistic vehicles)

SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Vehicle Commander

- External vision
 - o Direct view/vision blocks/optical sight
 - o Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary
- External auditory
- Radios
 - o Controls
 - o Displays
 - o Transmit/receive
- Sensor controls
 - o TV/LLLTV/IR
- Vetronics control/display (general purpose interface)
- Embedded Training display(s)
- Fire control (secondary role if dedicated gunner crewmember present; self-defense weapon always)
 - o Laser rangefinder controls (if present)
 - o Sight with or without radar/sensor/cue/status overlays
 - o Ammunition selection controls (including round type, charge, fuze, as applicable)
 - o Weapon azimuth/elevation controls (and displays)
 - o Firing control (trigger)
 - o Weapon guidance controls (if applicable)
- Tactical situation display (possible)
- Navigation system
 - o Map Display
 - o Inertial position/azimuth
 - o Map/compass backup
- Command and control displays/target handoff
- Environmental controls
- Maintenance/diagnostic controls/displays
- Intercom controls
- Resupply functional controls
- Uncooperative IFF controls/displays

SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Direct Fire Weapons Gunner

- Fire control
 - o Laser rangefinder controls
 - o Laser designator (if present)
 - o Radar controls and displays (if MMW radar equipped)
 - o Sight with or without radar/sensor/cue/status overlays
 - o Ammunition selection controls (including round type, charge, fuze, as applicable)
 - o Weapon azimuth/elevation controls (and displays)
 - o Firing control (trigger)
 - o Weapon guidance controls (if equipped with guided weapon)
- Intercom controls
- Tactical situation display (possible)
- Maintenance/diagnostic controls and displays (secondary role)
- Environmental controls
- Embedded Training display(s)
- Rearm function controls
- Uncooperative IFF controls and displays

SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Indirect Fire Weapons Gunner .

- Fire control
 - o Weapon selection/assignment
 - o Weapon status monitoring
 - o Weapon mount/launcher control (azimuth, elevation)
 - o Weapon launch control
 - o Weapon sensor monitoring (weapons with man-in-loop; e.g. FOG-M)
 - o Weapon guidance and control (man-in-loop only)
 - o Command interface (launch orders)
 - o Mission/fire mission planning displays/controls
- Intercom controls
- Maintenance/diagnostic controls and displays
- Environmental controls
- Embedded Training display(s)
- Rearm function controls and displays

SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Sensor/communications/EW operator

- External vision
 - o Direct view/vision blocks/optical sight
 - o Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary
- Radar/threat warning/EW sensor/EW/jammer controls and displays (as applicable)
- Radios
 - o Controls
 - o Displays
 - o Transmit/receive
- Sensor controls
 - o TV/LLLTV/IR/threat warning
- Vetronics control/display (general purpose interface)
- Target handoff controls/displays (some cases)
- Environmental controls
- Intercom controls
- Embedded Training display(s)
- maintenance and diagnostics controls and displays
- Uncooperative IFF controls and displays (as applicable)

SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Mission Equipment Operator

- Mission equipment controls and displays (vary widely)
- Environmental controls
- Intercom controls
- External vision (many cases)
 - o Direct view/vision blocks
 - o Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary
- Embedded Training display(s)

SOLDIER-SYSTEM INTERFACE EQUIPMENT SUITE

Position: Battle Staff

- Tactical situation display(s) and control(s)
- Radios
 - o Controls
 - o Displays
 - o Transmit/receive
- Sensor controls
 - o TV/LLTV/IR (possible)
- Target handoff controls and displays
- Environmental controls
- Intercom controls
- Navigation/position representation system
 - o Map Display (possibly multiple)
 - o Inertial position/azimuth
 - o Map/compass backup
- External vision (possible)
 - o Direct view/vision blocks/optical sight
 - o Indirect view (TV, LLLTV, IR/thermal) - includes controls as necessary
- Embedded Training display(s)
- Removable workstations (replicate tactical situation/-navigation controls/displays, target handoff, sensors [some cases], communications [some cases])

APPENDIX C

LIST OF ABBREVIATIONS AND ACRONYMS

LIST OF ABBREVIATIONS AND ACRONYMS

AC	Active Component
AMC	U.S. Army Materiel Command
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
ARTEP-MTP(s)	Army Training and Evaluation Plan-Mission Training Program(s)
ASAP	Accelerated System Acquisition Process
BIT	Built-in Test
BITE	Built-in Test Equipment
ET	Embedded Training
FPR, FPRs	Functional Performance Requirement(s)
HARDMAN	HARDware versus MANpower Analysis
HFEA	Human Factors Engineering Analysis
IR&D	Internal Research and Development
JMSNS	Justification for Major System New Start
MAA	Mission Area Analysis
MANPRINT	MANpower and Personnel Requirements INTEgration
MTD, MTDs	Maintenance Training Device(s)
NET	New Equipment Training
O&O	Organizational and Operational Plan
OJT	On-the-job Training
PITE	Plug-in Test Equipment
PM TRADE	Project Manager for Training Devices
PMCS	Preventive Maintenance Checks and Services
ROC	Required Operational Capability

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

SAD, SADS	Stand-Alone Training Device(s)
SIMNET	SIMulation NETwork
SM, SMs	Soldier's Manual(s)
SSI, SSIs	Soldier-System Interface(s)
STRAP	System Training Plan
TDR, TDRs	Training Device Requirements
TM, TMs	Technical Manuals
TRADOC	U.S. Army Training and Doctrine Command